CARBON MANAGEMENT, 2017
https://doi.org/10.1080/17583004.2017.1386533

Taylor & Francis
Taylor & Francis Group

Critical success factors for embedding carbon management in organizations: lessons from the UK higher education sector

Muhammad Usman Mazhar [a], Richard Bull [b] and Mark Lemon [b]

[a]Department of Management, Nottingham Business School, Nottingham Trent University, Burton Street, Nottingham, NG1 4BU, United Kingdom; [b]Institute of Energy and Sustainable Development, School of Engineering and Sustainable Development, De Montfort University, The Gateway, Leicester, LE1 9BH, United Kingdom

ABSTRACT

Organizations are under increasing pressure from governments and stakeholders to reduce carbon emissions from their business operations for climate change mitigation. Universities are not exempt from this challenge and are operating in a complex external environment, not least responding to the UK government's Climate Change Act 2008 (80% carbon reductions by 2050 as per 1990 baseline). In 2012–2013, the UK Higher Education (HE) sector consumed 7.9 billion kWh of energy and produced 2.3 million tonnes of carbon emissions. This indicates the scale of the challenge and carbon management is central to reduce carbon emissions. However, effective processes for implementing and embedding carbon management in organizations in general, and universities in particular, have yet to be realized. This paper explores the critical success factors (CSFs) for embedding carbon management in universities and, more widely, in organizations. This exploratory study adopted a mixed-methods approach including the content analysis of universities' carbon management plans alongside semi-structured interviews in the UK HE sector. The paper identifies six key factors for successfully embedding carbon management that are pertinent not just for the HE sector, but to organizations broadly: senior management leadership; funding and resources; stakeholder engagement; planning; governance and management; and evaluation and reporting.

KEYWORDS

Carbon emissions; carbon management; higher education sector; organizations; critical success factors

Introduction

Climate change and the rise of carbon emissions are emerging as one of the greatest challenges for organizations. At the Paris Climate Conference (COP21) in December 2015, 195 nations made ambitious commitments to reduce their carbon emissions. This threat of climate change and associated carbon emissions demands adequate measures for carbon management within organizations [1]. Business organizations can act as facilitators for reducing carbon emissions by designing, manufacturing and marketing clean energy supply alternatives and other strategies such as high-efficiency buildings, transport and equipment [2]. However, research on organizational factors affecting energy consumption and carbon emissions is relatively scarce. This could be due to disparities in data and the difficulty of generalizing across a diverse range of organizations that vary greatly in size, function, scope and interest [2].

The higher education (HE) sector is a growing consumer of energy and generator of carbon emissions. In 2012–2013, 7.9 billion kWh of energy was consumed within higher education institutions (HEIs), producing 2.3 million tonnes of carbon emissions [101]. The Higher Education Funding Council for England (HEFCE) reported that total HE emissions were 3.339 Mt CO_2 in 2005, a significant rise of 33% since 1990 [3]. This indicates the scale of the challenge. Therefore, HEFCE has encouraged universities to play their part in meeting national carbon reduction targets and demonstrating leadership to other organizations [4].

HEFCE adopted the national targets of reducing direct carbon emissions (scope 1 and scope 2), which against a 2005 baseline is equivalent to a reduction of 43% by 2020 and 83% by 2050 [3]. The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) classified scope 1 as direct carbon emissions that occur from sources owned or controlled by the organization and scope 2 accounts for emissions from the generation of purchased electricity. Scope 3 is all other indirect emissions that arise as a consequence of various organizational activities, but occur from sources not owned or controlled by the organization [5]. In response, universities developed carbon management plans (CMPs) and set individual carbon reduction targets to contribute to the national and HE targets. COP21 also urged universities to undertake more measures, such as showcasing universities as living laboratories for climate change mitigation and using

CONTACT Muhammad Usman Mazhar muhammadusman.mazhar@ntu.ac.uk

campus operations as a leverage agent to accelerate transition to a low-carbon economy [102]. This suggests a leadership role of universities in implementing carbon management and transformation of society.

This paper presents findings from a study exploring critical success factors (CSFs) for embedding carbon management in universities, and draws out what other organizations can learn from them. The paper first presents the theoretical background of carbon management in organizations and universities. The next section discusses the chosen research methodology, and then analysis and results are presented. In the last section, key findings and CSFs are discussed and conclusions are made with recommendations.

Organizations and carbon management

Organizations of all types are major contributors to global carbon emissions [6]. Carbon management makes good business sense for organizations [7] and it has been moving up the strategic agenda in the global corporate world, albeit slowly. Many organizations now understand the need to reduce their emissions due to multiple market drivers such as energy costs, the growing cost of carbon, brand reputation and business risks [8]. Organizations have begun to take steps to implement carbon management [9]. However, there is a significant relationship between an organization's carbon strategy, the sector it operates in and the size of the organization, due to the nature of business processes [10]. Research into the strategic response to climate change in public- and private-sector organizations found that carbon reduction was dependent upon how those organizations 'thought' about carbon emissions [11]. The frameworks underpinning corporate climate strategies are developed to reduce carbon emissions in energy-intensive companies within the manufacturing and process industries [12], and evaluation of greenhouse gas emissions and reduction is also carried out [13]. Cadez [14] explores corporate climate change strategies of carbon-intensive firms from three EU countries to identify configurations of firms pursuing similar strategies, and appraises the relationships between 19 carbon reduction practices and their underlying strategies. The public sector recognizes the benefits of carbon management even in the economic downturn and sees the short-term as well as long-term benefits of doing so [103]. The public sector has an opportunity to lead by example and influence the private sector [15]. There is a considerable gray literature on public-sector carbon management strategies, which is focussed on HE, local authorities and National Health Services (NHS) trusts. This suggests that, despite much good practice in the sector, proactive actions are required by public-sector organizations to reduce carbon emissions [104].

HEIs have huge potential to play a key role in supporting the transition to a low-carbon economy [16,17]. Bryan *et al*. [18] suggest that the most cost-effective opportunities to achieve carbon reduction exist within the further education and HE sector. In response, HEIs are increasingly reporting greenhouse gas emissions as part of sustainability performance measurement [19]. However, much of the focus on greenhouse gas emissions reductions and sustainability strategies in universities has been through the energy reduction of buildings and technical solutions in isolation. This is largely because they are significant contributors to an organization's carbon emissions and are usually under direct control [19]. Altan [20] provides insights into energy efficiency and carbon reduction interventions in the UK HEIs. The efficacy of some intervention strategies such as technical, non-technical and management are explored, which is a demonstration of the need for a joint approach. There is marginal attention paid to organizational innovations and institutional change required to address the problems. Wittneben *et al*. [21] argue that the theoretical developments in organizational studies and corporate practices for mitigating climate change have been obsolete. The review suggests that there is a lack of academic knowledge on carbon management in universities from strategic and whole organizational perspectives, and it appears to be an under-researched area [22]. Robinson *et al*. [23] (2014) argue that although HE carbon management is a pressing issue for leaders in universities, the research related to carbon management is in its infancy. Furthermore, there is still no knowledge and understanding of the key factors to embed carbon management in universities and organizations, and it has yet to be explored.

Research methodology

This study adopted a mixed-methods approach and was inductive and exploratory in nature, using content analysis and semi-structured interviews. CMPs of 18 universities (out of a total 161 UK universities) were systematically analyzed as part of the content analysis to explore universities' carbon management planning approaches and develop key themes associated with this process. CMPs present the official position of universities on how they are planning to implement carbon management. Eighteen semi-structured interviews were conducted to develop an improved understanding of carbon management success factors: 16 with middle and senior managers in estates and facilities management departments in universities, and two with key senior individuals from two other HE-sector organizations involved in carbon management to obtain a sector-level perspective. The content analysis represents 18 UK universities, nine of which also

Table 1. Interviewees, with job title and type of organization.

Interview no.	Job title	Type and description of university/ organization	Code
1	Environmental and Sustainability Officer	Post-1992 in East Midlands	University 1
2	Head of Estates Management	Post-1992 in East Midlands	University 1
3	Director of Sustainable Development	Post-1992 in East Midlands	University 1
4	Deputy Procurement Manager	Post-1992 in East Midlands	University 1
5	Director of Climate Change Policy	Post-1992 in East Midlands	University 1
6	Research Fellow	Post-1992 in East Midlands	University 1
7	Transport Coordinator	Post-1992 in East Midlands	University 1
8	Energy Manager	Pre-1992 in East Midlands	University 2
9	Energy Officer	Post-1992 in East Midlands	University 3
10	Carbon and Energy Manager	Pre-1992 in East Midlands	University 4
11	Sustainability Manager	Post-1992 in East Midlands	University 5
12	Environmental Manager	Post-1992 in East Midlands	University 6
13	Director of Estates and Buildings	Pre-1992 in East of England	University 7
14	Director of Estates	Post-1992 in North of England	University 8
15	Head of Environment and Energy	Pre-1992 Russell Group University in England	University 9
16	Chancellor	Post-1992 in West Midlands	University 10
17	Head of Sustainable Development	HE sector organization in England	Organization 1
18	Chief Executive Officer	Not-for-profit HE sector organization in the UK	Organization 2

HE: Higher education.

participated in the interviews. Therefore, a sample of 18 universities across the UK, using two research methods, is representative of different types and size of universities and may aid the validity, reliability and generalization of the findings. The sample includes new or post-1992 universities (former polytechnics or further education colleges) and relatively larger pre-1992 universities (Red Brick, Russell Group and the Plate Glass or 1960s universities). The interviewees were selected by emailing them directly, with a small proportion selected through networking and professional links of the researcher within the UK HE sector. This process ended with the selection of 18 researchers representing nine different universities. Nearly everyone responded to the emails, and nine more universities were selected across the UK for the content analysis of CMPs, to have a representative sample based on their size and type.

A set of questions relating to carbon management was drawn up in response to analysis of CMPs and initial discussions with members of the environment team at the researcher's home university. Semi-structured interviews were conducted face to face (12) and by telephone (six), depending upon the location and time commitments of the respondents, and lasted for between 40 minutes and an hour. The interviews were recorded and handwritten notes were taken. One interviewee was selected from each university, apart from the researcher's own university, where seven interviews were conducted. Table 1 presents details of the interviewees and their universities. The universities are categorized based on their year of foundation: pre and post 1992.

Table 2 presents names of the 18 universities chosen for the content analysis, with the titles of their carbon management documents and the year of publication.

This study was carried out between September 2012 and January 2014. However, it should be noted that five of the 18 universities have updated their carbon management plans in the last couple of years. However, the majority of the universities have not done so, perhaps because there is no accountability and compliance regime at present. This could be an impact of policy changes (HEFCE not being a source of capital funding anymore) in the HE sector, where universities seem to be operating as business organizations in a competitive market-driven environment.

The content analysis was carried out using the data analysis software package NVivo 10, to develop themes and support the interview study. The interviews were transcribed and organized for thematic analysis. The coding process was iterative, from the literature and previous models; then, through the analysis, common themes also emerged from the semi-structured interviews. As a result, six factors for successful implementation of carbon

Table 2. Demographics of universities chosen for the content analysis.

No.	Name of the university	Name of the document	Year
1	De Montfort University	Carbon Management Plan	2011
2	University of Leicester	Strategy and Implementation Plan	2007
3	Loughborough University	Carbon Management Plan	2010
4	Nottingham Trent University	Strategy and Implementation Plan	2008
5	University of Derby	Carbon Management Plan	2009
6	The University of Northampton	Carbon Management Plan	2011
7	University of East Anglia	Carbon Reduction Plan	2012
8	University of Cambridge	Carbon Management Plan	2010
9	Leeds Metropolitan University	Carbon Management Strategy	2012
10	University of Lincoln	Carbon Management Plan	2011
11	University of Nottingham	Carbon Management Plan	2010
12	University of Birmingham	Carbon Management Implementation Plan	2010
13	University of Bradford	Ecoversity – One Planet Strategy	2011
14	The University of Edinburgh	Climate Action Plan	2010
15	Heriot–Watt University	Carbon Management Plan	2009
16	Cardiff University	Carbon Management Plan	2013
17	Aberystwyth University	Implementation Plan	2007
18	Queen's University Belfast	Carbon Management Plan	2013

Figure 1. Critical success factors (CSFs) for embedding carbon management.

management are proposed. Figure 1 presents the outcome of the analysis.

CSFs for embedding carbon management

This section discusses the six CSFs to embed carbon management in organizations in general and universities in particular. These CSFs emerged from the content of the interviews and CMPs. The analysis of the data took account of outlying interview responses, but the generation of CSFs was based on a thematic approach and the most common themes considered to be significant in this study.

Senior management leadership

Leadership from senior management is presented as one of the most important components of carbon management process within universities, with almost all of the universities' senior management commitment reflected through their CMPs and other strategic documents. This suggests leadership at only policy and strategy levels, but success depends on engaged leadership and commitment through active participation and the deployment of resources required for implementation. The Director of Estates at University 8 argued that 'we need to lead by example', reflecting that senior management needs to lead the process. However, it is one thing to say so in a management plan and another to actually implement it. This research found that actual engagement of senior leadership is varied in universities. Eleven of the 17 interviewees mentioned that senior management is committed to carbon management, whereas six interviewees reported that there is a lack of senior management leadership and they presented it as a key barrier:

> *If there was a real commitment by the Vice Chancellor (VC) or by the Director of Estates, there should be more resources on that, you can compare these with the 'X University', they really put resources; money, human etc. (Research Fellow)*

While senior management has approved the implementation of carbon management in the majority of the universities by signing off on CMPs, this might not ensure their full engagement during the process and provision of resources, as this quote by the Chancellor of University 10 illustrates:

> *The whole question about properly embedded carbon management only works if it is driven by the VC and by the whole of his/her team. If it is stuck in the estates department …, then it's very unlikely that there will be the kind of buy-in that will be required to really drive behavior change.* (Chancellor)

In general, the directors of estates appear to be more committed to carbon management than other executive members. The Chief Executive Officer (CEO) of Organization 2 argued that middle managers are working in a difficult situation and are often restricted in estates department and have no authority over academics, deans and faculty leaders who are involved in strategic decision-making. Therefore, middle managers indicate that they would need the full support of senior management, which they do not seem to have currently. Crucial here is the fact that the link between capital funding (which was promised in 2008 by HEFCE) and carbon performance does not exist anymore due to the introduction of tuition fees and the abolition of student number control in 2013.

Funding and resources

Funding and resources are critical for organizations to effectively implement carbon management, and universities are no exception. Thirteen of the 18 interviewees declared that funding is important for implementing carbon management strategies and the process cannot be implemented without it, whereas three interviewees argued that funding tends not to be a problem for implementation. This indicates two contradictory arguments. The 13 interviewees mentioned funding as one of the major barriers, but, in contrast, the same three interviewees argued that it is not a barrier. They believe that funding is perceived to be a barrier but carbon management can still be implemented without sufficient funds.

> *I think a lot of it is to do with coming up with projects and then having the funding to be able to put projects in place really … so we have funding from various different places to do different projects.* (Sustainability Manager)

In contrast, the other group of interviewees argued that funding should not be a problem for implementing carbon management, as there are low- and no-cost

measures related to behavior change and engagement. But, as the Energy Manager from University 2 noted, 'it is perceived to be the main thing'. The Director of Climate Change Policy at University 1 supported this argument and stated that funding should not be an excuse for inaction by middle managers:

> *The money is important because energy efficiency tends to be capital intensive, so of course it's important, but it tends not to be the problem in most cases*. (Director of Climate Change Policy)

This indicates that funding is important for large-scale projects, but it should not be a major barrier in some cases. However, universities have not been able to invest significantly in projects due to a lack of funding, particularly after the changes in the funding regime. There are more business opportunities to invest. The disagreement between the interviewees on the issue of funding could be due to the size and strategic priorities of the university, which could have influence on this. At present, universities have multiple internal and external sources of funding available to them. The main sources of internal funding include tuition fees, commercial income, properties disposal and maintenance budget. The external sources could be funding from the HEFCE, Revolving Green Fund (RGF), Salix Finance Ltd. loans and recycling fund, funding from the research councils, renewable energy incentives and charity donations. The construction and maintenance budget can serve a dual purpose in universities: carbon reduction and new construction/refurbishment. However, these sources of funding reflect that many of the universities lack a dedicated budget for carbon management.

Recently, changes in the funding regime, for example an increase in tuition fees and removal of the cap on student recruitment, may have implications for middle managers while implementing carbon management, as they are already working under tight financial budgets. An Energy Manager at University 2 argued that carbon management funds can compete against the internal budget for important core business activities such as teaching and research. The Energy Manager contradicted the argument of the Director of Climate Change Policy and mentioned that carbon management needs heavy investment for delivery. Currently, this university seems to give low priority to carbon management and might not be in a position to invest due to other core business areas. The Energy Manager argued that investment is needed to deliver carbon reduction, but there are priority issues. Due to this, the university aims to invest within limits and priority remains with the core business.

> *At some stage big numbers as in millions of pounds need to be invested to deliver the tonnes of CO_2. What the university has said that in delivering the targets and delivering the sustainable campus, they won't bankrupt the university*. (Energy Manager)

Although this study illustrates that universities have different funding and resource opportunities available to them, the role of capital investment funding is key, as Loughborough University's CMP states:

> *Significant capital investment will be required to both assess the feasibility [of] and implement major infrastructure projects that will deliver significant carbon benefits. A full review of the grants and financial support that are available at both a local and national level should be undertaken periodically to ensure the university maximise the funding opportunities that are available.* (Loughborough University Carbon Management Plan, p. 7)

This indicates that universities explore multiple funding options to maximize opportunities because one source of funding may not be enough to implement the planned projects.

Stakeholder engagement

Stakeholder engagement emerged as one of the key themes in CMPs. Half of the CMPs (nine) mentioned the role of stakeholder engagement for the effective delivery of CMPs. Universities are attempting to engage different stakeholders, which is considered an important part of the carbon management process, and all of them are trying to achieve results through various engagement initiatives. However, a lot more work needs to be done and there is not adequate evidence of effective stakeholder engagement in universities. There is no benchmark or indicator against which engagement can be measured. CMPs do not explicitly identify stakeholders relevant to carbon management and do not present strategies to engage them. However, universities discussing stakeholder engagement have an agreement that carbon management needs effective engagement and response at all levels for embedding carbon management. The University of Nottingham emphasizes its ambitious organization-wide stakeholder engagement, but it seems that this is not there yet in many of the universities.

> *The Plan requires engagement at all levels of the university – from individual behavioural changes to institution led initiatives – in order that the objectives are understood and that contributions are made to maximise delivery of the targets. We want to foster a 'can do' approach and response across the university.* (The University of Nottingham Carbon Management Plan, p. 2)

Universities have a range of internal and external stakeholders, but carbon management is mainly discussed from staff and student perspectives. The content analysis indicates that CMPs do not discuss wider stakeholder engagement. The Head of Sustainable Development at Organization 1 discussed the role of internal and external stakeholders and suggested a collaborative approach:

> *I think it relies on combined action from a number of people including sector bodies like the Association of University Directors of Estates (AUDE) has done tremendous job on carbon reduction, like Universities UK and Guild HE and the National Union of Students (NUS). I think it*

> *probably needs students as well to be vocal and clear that it is important to them.* (Head of Sustainable Development)

Staff and student engagement

Universities are trying to engage staff and students with appropriate engagement strategies. Ten universities (out of the 18) have clearly elaborated the potential role of staff and students and their engagement in the process. Loughborough University's CMP highlights an important role of staff and student engagement:

> *If the university is serious about meeting the challenge of achieving the targets set out within this plan and be[ing] seen as a leading low carbon campus within the Higher Education sector, every member of staff and the student body needs to engage in the carbon agenda.* (CMP Loughborough University, p. 3)

Ten of the 18 interviewees mentioned the issue of behavior change for staff and students as an important barrier and indicated a lack of staff and student engagement. The majority of these interviewees were middle managers from estates and facilities management.

Five interviewees argued that university managers need to change the behavior of stakeholders to enhance engagement. They are focused on a range of staff and student engagement strategies, for example participating in the National Union of Students (NUS) Student Switch Off and Green Impact campaigns to engage staff and students. As far as staff (both administrative and academic) is concerned, this is the issue at both middle and senior management levels. Staff and student engagement can help in making informed decisions toward carbon management. For example:

> *The final issue regards the involvement of the student body. This is a critical determinant of whether or not carbon management plans are likely to work.* (Chancellor)

Also:

> *The biggest issue is the engagement of staff in terms of people in buildings who use energy in buildings and engagement of staff at senior level to get them to understand that carbon management is a crucial part of their duties.* (Director of Sustainable Development)

The issue of engagement could be due to a lack of knowledge and understanding of environmental issues, and a focus on their main duties (education or work). An Environmental and Sustainability Officer at University 1 mentioned the Green Impact and Student Switch Off campaigns as the key engagement tools, but most of the universities are implementing these projects, as reflected in their CMPs. The majority of universities (10 out of the 18) have clearly elaborated staff and student awareness and engagement activities in their CMPs. Many a time, energy is seen as a commodity and not the carbon emissions embedded inside its use. Carbon is often not addressed adequately and people behave in response to energy reduction and not the production of carbon emissions. However, carbon emissions could be a valuable commodity for universities due to carbon taxes.

Students' unions have been active recently to reduce emissions through Green Impact and Students' Green Fund initiatives, but there is not as much involvement as universities would like to see across staff and student populations. CMPs do not provide enough evidence for wider stakeholder engagement and how effective staff and student engagement has been. The Transport Coordinator at University 1 argued that it is difficult to change behavior, because people find easy ways to do things and many of the individuals have wrong perceptions of the environmental agenda. The Head of Environment and Energy at University 9 complemented this argument and indicated a lack of engagement:

> *Well, the experience is staff and student engagement is very difficult because most of us think that we don't pay the electricity or who collects our waste, we don't care. So, yes it's a part of awareness and engagement* (Head of Environment and Energy).

A NUS representative highlighted that student representatives should be engaged in all agendas across HE, especially in the new post-fees regime, when students are at 'the heart of the system'. NUS believes that students want their institutions to embed sustainability in their operations, but there is an issue of greening the curriculum. Attempts are made to do so, but it is challenging. It is believed that universities have a bigger role in the environmental education of future leaders than only managing their own environmental impact. The survey carried out in De Montfort University's Green Impact project indicates that students consider environment an important issue, but they have a lack of knowledge and understanding, leading to a low level of engagement.

Communication

In the content analysis, communication emerged as an important theme and the majority of the CMPs discuss communication for effective stakeholder engagement. Communication is related to all aspects of carbon management in a university, ranging from communicating energy and carbon emissions data to stakeholders (staff and students) to carbon management targets and strategies, and the performance against the targets. Communication is also a key performance indicator in the 'Carbon Management Matrix', which is used to evaluate carbon management performance. Four interviewees mentioned communication as an important part of the carbon management process and declared that they have strategies to communicate carbon management issues to different stakeholders. This can include internal and external communication. The interviewees were of the view that, ideally, targets and

strategies need to be communicated to all of the stakeholders to achieve better results, and the performance should be communicated through different channels to motivate them about achievements. The Director of Sustainable Development at University 1 stated:

> *Communication to students, stakeholders and staff about what's going on and what's been achieved is key, so they feel involved in the process*. (Director of Sustainable Development)

Terms such as 'sustainability' and 'carbon management' seem to be complex and difficult for staff and students to relate to. Two of the four interviewees who emphasized communication made this point in the interviews and, furthermore, the need for effective communication to spread the message across was described by a Carbon and Energy Manager at University 4. He noted that communication is the main challenge and could help with embedding carbon management into the organization by developing its understanding; otherwise, it may remain an estates issue:

> *It is important for us in terms of communicating our strategy, so that it is embedded into the institution and I would say that perhaps communication is one of the biggest issues*. (Carbon and Energy Manager)

Three interviewees discussed that there is a lack of communication that needs addressing. Overall, communication was not discussed widely by the majority of interviewees. It appears that universities are communicating on ad hoc basis, and more can be done. The Director of Sustainable Development at University 1 argued that managers seem to focus on technical solutions and neglect the human factors. University managers cannot put technologies in place without having communication with individuals as they use the technologies. This suggests that technology alone cannot solve the problems and it needs to be integrated with awareness raising and behavior change, but this is lacking.

> *People are taking a technical solution to things … but you can't put the technology by itself without talking to people; it's people that use the technology*. (Director of Sustainable Development)

Planning

Universities in England were required to develop individual carbon reduction targets, strategies and CMPs for addressing scope 1 and 2 emissions [4]. All of the universities now have CMPs. The majority of the CMPs are publicly available on websites, but one university has provided restricted access to only staff, and another university has only put a summary on the website. Three of the eighteen universities are in the process of updating their CMPs to measure performance and include future strategies. This indicates that strategies and plans do not often get updated regularly and are static documents. The review of CMPs can allow universities to consider changing investment priorities, and evolving opportunities to be accommodated. At one university, the academic faculty plans have a separate section on environment and sustainability issues:

> *We have a carbon management plan as you know universities do with a carbon reduction target and we are currently very much focusing on scope 1 and scope 2 emissions*. (Head of Environment and Energy)

The Head of Environment and Energy at University 9 argued that the university needs an evidence-based strategy that has buy-in from all of the stakeholders:

> *I think it's about having a strategy and plan in place that's based on evidence that has buy-in across the university from all the key players and senior managers to people working in the area that can have an influence, lot of people in procurement, finance, estates departments, etc. It's about having an idea how you are planning to move forward and meet targets*. (Head of Environment and Energy)

Interviewees were asked about the effectiveness of CMPs based on their experiences. The majority of the interviewees reported that universities have been fairly successful in their plans. Universities have started to be structured in their strategic planning and in taking carbon management seriously. CMPs have been a helpful tool to reduce emissions. CMPs have given the sector a common language of measuring, managing and reporting emissions and have put universities on a pathway. This could help in consistency within the sector:

> *Yes, carbon management plans are making progress and they are pragmatic. We also have a standard sector language*. (Director of Estates)

In contrast, three interviewees criticized some aspects of CMPs and mentioned gaps. One of them argued that CMPs are a good start and help in getting recognition from senior leadership and stakeholders such as staff and students. The content analysis suggests that CMPs have a lack of flexibility and there seems to be uncertainty associated with future changes in universities. CMPs are developed with future predictions about student numbers, provision of facilities and the projects, which may go wrong:

> *The problem with carbon management plan is you write it at a point in time and try to predict what's going to happen over the next few years in terms of student numbers and new buildings and other things, but you can't predict accurately, so things happen and decisions are made that you didn't know at the time when you wrote it, so yes things change, so it's difficult.* (Environmental Manager)

Operational boundaries

All of the universities in this study have measured different streams of carbon emissions from their business operations and have set carbon reduction targets as part of CMPs. The boundaries of carbon emissions measurement and management have received much

attention in the sector. Nine of the 18 universities' CMPs indicate that universities have measured only scope 1 and 2 emissions, and eight universities have measured them with 'selected parts of scope 3 emissions'. Only one university has measured its complete carbon footprint based on scopes 1, 2 and 3. The selected parts of scope 3 emissions are related to waste and water because these are relatively straightforward to measure and data is readily available. In addition, five interviewees mentioned scope 1 and 2 as the boundary of carbon management, whereas 15 discussed challenges around scope 3 carbon management even if they are not effectively managing these emissions. The Sustainability Manager at University 5 explained the boundary:

> *We predominantly have been focusing on scope 1 and 2 at the moment. Scope 1 and 2 are most important for us in estates and it also gives us best payback in terms of spending money. It's the thing that we have target set from HEFCE. The mandatory targets are for scope 1 and 2 only, whereas scope 3 is not mandatory, also scope 3 is more difficult to tackle.* (Sustainability Manager)

With regards to scope 3, universities have started their journey to measure and manage these emissions, as the University of Birmingham notes:

> *Work is being undertaken to gain a greater understanding of the university's scope 3 emissions. At this stage, quantification of a baseline for scope 3 emissions will be the first target. Subsequently, meaningful reduction targets will be established for scope 3 against the baseline.* (University of Birmingham Carbon Management Implementation Plan, p. 8)

Obviously, if managing scope 1 and 2 emissions is a challenge, then scope 3 is even more complex. The Director of Estates at University 8 stated that 'the reality is focus of scope 1 and 2 and it makes sense, but scope 3 is not easy'. In regard to targeting, the content analysis found that, presently, universities have only set targets for scope 1 and 2. The University of Lincoln's CMP and the University of Bradford's Ecoversity – One Planet Strategy have carbon emissions reduction targets of 43% and 50% (scope 1 and 2) by the year 2020, respectively. However, the majority of interviewees discussed that scope 3 carbon management is emerging on universities' agenda, but it is not done yet. Scope 3 carbon management is not mandatory for universities. The Director of Estates at University 8 stated: 'scope 3 is a starting headline'. Fifteen interviewees discussed their plans and approaches to scope 3 emissions measurement and management. These are indirect emissions where universities currently do not have carbon emissions reduction targets and plans, because not all universities have measured these emissions.

There are barriers to scope 3 carbon measurement and management, which are mainly related to data management. Once universities have good-quality data and have measured their scope 3 emissions, then they can set baseline and targets with carbon management strategies. Although universities do not have scope 3 carbon footprints and targets, they have been undertaking some measures to reduce these emissions. The Director of Estates at University 8 commented on the barriers to scope 3:

> *It is hard and you have to make assumptions. Trying to achieve the data is impossible and you need to make some sensible judgments*. (Director of Estates)

HEFCE proposed universities should commit to making reductions in scope 3 carbon emissions. As a first step, HEFCE advised universities to monitor and report scope 3 emissions, including the measurement of a baseline by December 2012 and setting targets for scope 3 emissions by December 2013 [3], but the sector missed this deadline and the policy seems uncertain about it:

> *Our supply chain is very big, so we have a huge influence of what we buy. We tend to buy different things to reduce our supply chain emissions. We could have an impact on how our staff and students commute to the university and obviously change our commuting footprint and also our business travel footprint.* (Environmental Manager)

Carbon reduction targets

Carbon reduction targets are a key constituent of CMPs for universities. The HEFCE set the targets for 2020 and 2050, but the universities have set only targets for 2020. This may be because 2050 is simply too far away to make a calculated predicted target, and campuses will change drastically in 30+ years. The targets vary; some of the universities have very ambitious targets, whereas some of them have relatively less ambitious targets. For example, one pre-1992 university has a 60% reduction target by 2020, based on scope 1 and 2 emissions. An Environmental and Sustainability Officer at University 1 stated that the university has adopted the same targets as HEFCE. Some of the universities have interim and/or annual targets to track their progress. For example, a post-1992 university developed a main target with two interim targets (12% by 2012 and 29% by 2017). According to the Sustainability Manager at University 5, the annual targets are internal targets and are not advertised externally.

In contrast, some universities do not have interim targets. For example, a Russell Group university does not have annual targets, but the university tracks its progress for annual reporting. The Head of Environment and Energy at University 9 called the carbon reduction targets unrealistic and an aspiration, but universities report their targets and the subsequent progress both internally and externally. Alternatively, this could be interpreted in a positive light:

> *It is important to have a target, a target which is a stretch target, but also realistic and achievable*. (Sustainability Manager).

The Head of Sustainable Development at Organization 1 revealed that individual institutions that have produced targets for 2020 make a total aggregate of 38%. The HE sector's overall reduction target is 43%, so there is a gap of 5% between the collective institutional targets and the agreed target of the sector. Carbon Credentials [24] found that the HE sector has only reduced carbon emissions by 9% against the 2020 target since 2005/2006. Therefore, significant carbon emissions reductions need to be achieved in order to meet the 2020 target [25]. The targets are set against a baseline to benchmark performance and it varies among universities. The majority of universities have 2005/2006 as the baseline, because data is available to calculate emissions for this year. However, some universities have adopted 2004/2005 and 2007/2008 baselines due to their own circumstances, as found in the analysis of CMPs.

Absolute and relative targets. There are two types of carbon reduction targets, absolute and relative, and only two respondents made this distinction. HEFCE and the national targets are absolute. The relative carbon reductions allow universities to grow in business and estate development. In spite of being more efficient, carbon emissions still rise with growth, but relative carbon emissions are reduced. The relative targets are measured against matrices of per Full Time Equivalent (FTE) students, per meter square floor area or per unit turnover. Currently, universities seem to be more focused on relative targets for performance measurement and reporting; they are also starting to realize that they are not achieving real reductions with relative targets. In contrast, absolute targets are difficult to meet for research-intensive (e.g. Russell Group universities) and growing universities, as absolute targets may inhibit university growth. The Director of Climate Change Policy at University 1 criticized relative targets:

> *The minute I see, per student or per square meter, those are all relative numbers and very distracting relative numbers*. (Director of Climate Policy)

The CEO of Organization 2 argued that the debate on absolute and relative targets has received much attention. He was of the view that relative reductions allow universities to grow. Universities become more efficient, but carbon is still rising and they think this is fine, we are being more efficient per student but we have grown twice the size. This suggests that relative targets can be used, but absolute targets need to be met for climate change mitigation.

Governance and management

Governance refers to all the processes by which policies and strategic decisions are made [26]. It offers a mechanism for carbon management strategies to be implemented. Governance aims to manage a diverse range of elements during the carbon management process. However, the term 'governance' is used in different contexts in CMPs and does not seem to be well understood. It came up as a theme and has subthemes necessary to implement carbon management. Eleven of the 18 universities' CMPs discuss governance of carbon management, and the emphasis seems to be on the structure and responsibility perspective. Therefore, the role of governance and accountability is key:

> *In order to ensure that there is effective and ongoing ownership of the carbon management programme, it is important to define a governance or accountability structure for the programme*. (Loughborough University CMP, p. 40).

In contrast, three interviewees specifically mentioned governance with regard to carbon management, despite the fact that they discussed other related issues that may be within the domain of governance. However, it seems that this is not the case for every university, and it might need to be addressed strategically. The analysis of CMPs suggests that universities tend to have a hierarchal governance structure to assign responsibility for carbon management and develop ownership. The Deputy Procurement Manager at University 1 argued that the procurement department has a small team to work on governance-related issues. Currently, the progress does not seem to be satisfactory and more work needs to be done with faculties and departments for effective governance and management:

> *We are a small team, we are not very well. We need to work much well with faculties and the departments*. (Deputy Procurement Manager)

The above statement suggests that carbon management is not integrated in the procurement process, mainly due to a lack of resources within the team. In regard to governance, the interviewees were asked about the overall success of carbon management in universities, as performance is indicative of effective governance. The responses suggest that, in general, the performance of universities seems to be satisfactory from governance and management perspectives and they are moving in the right direction. However, there is a long way to go, indicating a lack of effective governance. The HE sector seems to be doing well in some areas with leading initiatives such as planning, targeting, scope 3 study and partnering and has achieved a distinct status in terms of carbon management within the public sector. This suggests that there is good practice in the sector, but the performance of universities varies, with some universities doing well and some struggling to perform well. The Head of Sustainable development at Organization 1 argued that 'sharing a good practice is really helpful, what works and what doesn't'. HE is facing a range of challenges, and the Head of Sustainable Development at Organization 1 supported this:

> *I think there are examples of outstanding practice which would compare with anything in the world, to be honest*. (Head of Sustainable Development)

In contrast, the Director of Sustainable Development at University 1 had contradictory views:

> *Universities are years behind than other organizations in looking at their carbon emissions, they have been very slow to do it*. (Director of Sustainable Development)

Integrated and comprehensive whole-organization approach

Ten interviewees suggested adopting an integrated and comprehensive approach to governance for embedding carbon management within the organization. This is the 'whole-organization approach', which emerged in the content analysis. The main challenge for integrated governance is to explore 'how to achieve' it, when at present it is not discussed comprehensively in CMPs. A Research Fellow at University 1 defined an integrated and comprehensive approach as a benchmark for universities, which involves carbon emissions from all sources, both direct and indirect. Therefore, carbon management needs an embedded approach whereby low-carbon strategies need to be incorporated into the thinking and approach of individuals, departments and the university as a whole:

> *I think it needs to be embedded in the thinking and approach of the whole university*. (Head of Sustainable Development).

In order to respond to the need for an integrated and comprehensive governance approach, an Environmental and Sustainability Officer at University 1 argued that the university has adopted this approach by integrating scope 1, 2 and 3 emissions, rather than focusing on direct energy consumption.

Responsibility

Responsibility for carbon management was a key factor highlighted by both interviewees and CMPs. The content analysis divided responsibility into middle managers, working/task/steering groups and all stakeholders within a university. This suggests that responsibility is both dispersed in UK universities and lacks clarity and consistency. However, the interview study found that responsibility can be divided into three main categories, which differ from the prior three groups of the content analysis:

- Everyone
- Estates department
- Vice Chancellor (VC) or senior management team

The majority of the interviewees (10 of the 18) stated that while overall responsibility for carbon management rests with everyone within the university, the estates departments are only responsible for implementing strategies:

> *I think everybody has got a responsibility, staff and students have got responsibility to play their part. I know lot of the time it is seen as estates role, but I think it's much wider than that*. (Environmental and Sustainability Officer)

The role of staff and students is emphasized in the above extract. The middle managers in estates want them to take the responsibility. For the carbon management process to be successful, wider responsibility is essential. Senior management has a responsibility in terms of the strategic decisions they make within the university which could have a significant impact on carbon management. This indicates that aspects of responsibility lie within leadership. The role of academic staff is often overlooked and the majority of the CMPs do not highlight their role:

> *Academics are notorious at thinking that this is somebody else's responsibility, and therefore something they can just leave to somebody else, preferably a specialist*. (Chancellor)

From a hierarchical point of view, 'operational responsibility' rests on energy managers, who normally report to the Director of Estates, who in turn might report to a member of the senior management team. The estates managers are middle managers; however, they do not have control over strategic decisions:

> *The Sustainability Manager will be responsible for developing and implementing the carbon management strategy and producing interim reports*. (Leeds Metropolitan (now Beckett) University Carbon Management Strategy, p. 6)

Seven CMPs discuss strategic responsibility relating to carbon management; this varies from university to university depending upon the organizational structure. Four CMPs mention that the Director of Estates has strategic responsibility, whereas two report that it lies with the working or task group consisting of internal stakeholders:

> *Strategic carbon management is the responsibility of the Director of Estates and Commercial Facilities. Day-to-day operational carbon management responsibility lies with the Carbon Reduction Manager (a full-time post created in September 2010)*. (University of Lincoln Carbon Management Plan, p. 23)

In contrast, only one CMP states that the Pro Vice-Chancellor (PVC) has strategic responsibility, suggesting that there is a lack of strategic responsibility in universities at a senior level:

> *The Pro-Vice-Chancellor for Institutional Affairs has specific responsibility for carbon reduction and sustainability*. (University of Cambridge Carbon Management Plan, p. 24)

The content analysis indicates that while discussing responsibility in CMPs, there seems to be a lack of

clarity on the divide between operational and strategic responsibility.

Evaluation and reporting

Evaluation and reporting of carbon management performance emerged as a significant factor in the content analysis of the CMPs. This may help in measuring the progress made against the set carbon reduction targets:

> *To ensure continued reduction in emissions is maintained, it is essential that the programme, projects and the carbon reduction plan are regularly reviewed*. (University of East Anglia Carbon Reduction Plan, p. 33).

Universities aim to evaluate and report progress through different channels, and there are a variety of reporting mechanisms available. However, there is no evidence of integrated reporting. Universities report progress against CMPs through their annual reports which review the annual performance of carbon management against set targets and projects:

> *An annual report will be produced to monitor and report on our progress and performance achievements against this plan and to provide an update on the CO_2 reduction projects that will ensure that the remaining targets and objectives are met.* (The University of Nottingham Carbon Management Plan, p. 2)

The majority of universities (13 out of the 18) have adopted similar reporting procedures. Middle managers, who are responsible for implementation, report progress to a senior management group or committee. The senior management group or committee is usually chaired by a senior manager, who is a member of the senior management team. The senior manager can be a Pro/Deputy Vice Chancellor to ensure the high-level championing of carbon management on the university's executive board, or senior management team and governing council. Cardiff University describes its internal reporting mechanism as follows:

> *The Carbon Management Plan Task and Finish Group are currently developing the CMP, which will then report through the Environmental Management Systems (EMS) Steering Group, which is chaired by the Deputy Vice-Chancellor, which will oversee implementation and further development of the plan.* (Cardiff University Carbon Management Plan, p. 3)

At an operational level, four CMPs mention that universities have adopted a series of key performance indicators to monitor and report carbon management performance. These include universities' total CO_2e emissions, CO_2e emissions per £ million turnover or per FTE staff members and students. The focus of the reporting seems to be more within the organization than external to it. However, universities do report externally through mandatory and optional policies and schemes in the UK. HEFCE requires universities to measure and report progress against the sector-level targets, but there is a lack of consistency in reporting within the HE sector. Universities have varied internal reporting mechanisms. Moreover, external reporting does not seem to be consistent, because there is no standardized procedure or infrastructure for universities.

Discussion and conclusions

In the UK, the HE sector is hugely significant in terms of population, economic contribution and societal influence, and therefore represents an important sector for carbon management [27]. This paper has argued that many HE managers can be vague about the key factors for embedding effective carbon management processes. The paper has identified six critical success factors (CSFs) that can contribute to this and posits that other organizational sectors might learn from them, both in the UK and abroad. These factors are important to address key management issues within universities and organizations. The CSFs are:

- Senior management leadership
- Funding and resources
- Stakeholder engagement
- Planning
- Governance and management
- Evaluation and reporting

Energy is a major component of carbon emissions. Universities and other organizations can plan to reduce energy consumption by paying more attention to these CSFs. Therefore, these factors can potentially inform energy management as it is linked with the carbon management process. Engaged senior management is the starting point in carbon management, and universities need to engage them effectively. It is crucial that the CEO (VC in case of universities) prioritizes the implementation of carbon management measures [7]. The key challenge is to persuade them. They may not be persuaded by carbon reduction, but may be more sympathetic if it is linked to the core business through a sound business case or pursuit of the public good. Once senior management leadership is committed, funding and resources are allocated, which is a key factor. This may help realize the funding and resources that are essential for middle management who are likely to be responsible for implementing the carbon management strategies, as suggested by Czerniawska [28]. CSFs have relative importance. For example, senior management leadership can have implications for other elements of the carbon management process such as funding and resources, which can facilitate stakeholder engagement and planning processes.

A clear business case and contribution to the public good, including environmental good practice, will also contribute to the buy-in and, ideally, active support of the wider stakeholder network (staff, students, customers, suppliers, etc.). Wen [29] suggests the need for

effective stakeholder engagement and Williams and Kemp [30] state that education for sustainable development (ESD) is an important component of successful carbon management. Framing of employee engagement should acknowledge the positive contribution employees can make, rather than treating them as a 'problem to be solved' [31]. All universities have responded to HEFCE policy guidelines on carbon management and produced carbon management plans (CMPs) [23]. CMPs have encouraged universities to start the journey. Without senior management support and associated funding, these plans have often not realized their intended projects and carbon reduction targets. This highlights the need to consider the CSFs and carbon management as holistic and interconnected. It focuses on the need for plans to be flexible and able to respond to institutional changes; for example, universities are expanding in terms of student numbers and size of estate, and this is often not taken into account in the development of CMPs which can appear to be static reflections of a particular moment in time and policy environment.

The need to have a clear yet flexible CMP that is aligned to core business strategies and supported from 'the top' and by stakeholders highlights the importance of effective governance across the organization, not just in estates, but at all levels. This is key to embedding the process as part of the organizational culture. Successful governance and management will require all stakeholders to take responsibility for good practice, in terms of both its formal implementation and the 'way of doing things' within the organization. Nejati *et al.* [32] argue that everyone has a moral duty of sustainability and reducing carbon emissions. Formally, there needs to be clarity over both strategic and operational responsibility. The final success factor is evaluation and reporting. Reporting emissions is an important step in this process [15]. Organizations need to be able to monitor the effectiveness of the carbon management process both in terms of quantitative measures (e.g. scope 1, 2, 3) and through the behaviors of all stakeholders within the organization; the latter is often ignored, in large part because it is not a requirement of carbon policy. Scope 1 and 2 are established and scope 3 is ignored in measurement, management and reporting. However, scope 3 is likely to be a significant part of the carbon footprint [23].

Ozawa-Meida *et al.* [33] recommend comprehensive carbon footprinting and management. All of this requires consistent methods to measure and report organizational emissions, as suggested by Turner *et al.* [34]. Wright *et al.* [1] argue that the term 'carbon footprint' needs a universally accepted definition before a consistent and comparable methodology is developed. It is recognized that the difference in seniority levels among the interviewees may impact the CSFs. Of the 18 interviewees, six were senior managers (director and above) and the remainder mainly middle managers responsible for the delivery of carbon management strategy. Unsurprisingly, the senior interviewees paid more attention to the strategic management issues whereas middle managers, particularly in estates, identified critical factors that were more related to the delivery of carbon management, while recognizing the importance of strategic issues such as leadership, and funding and resources. However, the fact that both groups highlighted senior management leadership does reinforce its position as one of the most important CSFs. While there was a different emphasis paid to the success factors by senior and middle management, the common themes were taken to be significant. While a different respondent cohort might have altered the distribution of CSFs, the authors are confident that it would not have changed their overall make-up.

A final point refers specifically to carbon management within the UK HE sector. There is a question regarding what will drive universities to pursue leadership in carbon management. Universities have done significant work in some areas of carbon management, and some areas need improvement. HEFCE's approach in 2008 was to link central funding to carbon reduction targets. Now universities are in uncharted territory, responsible for setting their own fees and operating in a deregulated market with no limit on student recruitment. In essence, they are now operating as private-sector organizations in the same way as any other business. They are highly attuned to the needs and requirements of students as (this paper tentatively suggests) customers. Universities UK [35] finds that around half of undergraduate students now consider themselves customers of their university. Students' perceptions of value for money are higher than ever before and they expect to obtain employment opportunities, experience of studying with good facilities, high-quality academic staff and personalized feedback.

This shift could be damaging for carbon management in HE. Despite the challenges the UK HE sector is facing, there is a need for organizations to learn from what universities have done, as universities are relevant organizations to assess the applicability of and gain insights into the carbon management processes. Universities can act as good influencers of carbon management in other business organizations and wider society [36]. The six CSFs for embedding carbon management are pertinent not only for universities, but to organizations more broadly. This study comprises content analysis and interviews with managers at different levels in the UK HE sector. The research has produced insights and findings which are likely to be indicative of the broader HE sector. However, future research can carry out a large number of interviews with increased representation of stakeholders in universities. Further research could also indicate which CSFs may be more important than others. Similar research can be conducted in corporate business organizations, for comparative analysis by understanding how other sectors are dealing with such issues in the UK.

Recommendations

While this study was based on the experience of UK universities, recommendations are drawn out for organizations in general as there are commonalities between universities and business organizations. These recommendations are applicable to enhance the implementation of each CSF for embedding carbon management:

- Senior management leadership needs to understand business opportunities, risks and strategic implications of carbon management. The Vice Chancellor or CEO or a member of the senior management team must lead by example and take full responsibility for the performance and targets set. Carbon reduction targets and budgets can be devolved within individual departments to develop ownership. Senior management needs to be communicated with, comprehensively trained and engaged in business language with evidence and good practice case studies. The way forward is to create business cases to align carbon management with the core business as part of process innovation, and justify that 'carbon management = savings'.
- Government should introduce innovative funding mechanisms to tackle the lack of funding. Organizations should consider borrowing funds through private-sector suppliers and Energy Service Companies (ESCOs) for technical expertise and risk mitigation. Organizations may also explore the option of crowd funding. Furthermore, human resources (HR) departments have a key role and should be involved by embedding carbon management in recruitment and retention, job descriptions, training and development, and contracts and performance appraisal at all levels.
- Stakeholders, both internal and external, must be engaged due to their wider impact. Environmental managers need to understand the needs of different stakeholders and make carbon management as relevant as possible. Organizations need a coordinated approach and departments need to go beyond their boundaries. All of the stakeholders need to be educated and made aware of carbon management and their role by developing a shared understanding that they are jointly responsible for developing organizational capabilities for it. Sustained behavior change campaigns with simple messages and carbon literacy can develop interest to facilitate engagement.
- In planning, CMPs need to be optimized with built-in flexibility and should be dynamic, which can provide relevance, impact and effectiveness despite changes in organizations. CMPs must address both operational and strategic issues, aligning with the corporate strategy. Managers need to make CMPs easy to understand, engaging and publicly facing to enhance stakeholder engagement. Organizations should focus on meeting absolute targets (scope 1, 2, 3) to achieve real reductions for mitigating climate change. However, both relative and absolute targets can be reported as long as overall emissions are decreasing, to provide adequate understanding of the performance.
- Carbon management needs an integrated and comprehensive whole-organization governance approach by being incorporated into all business activities across departments. Organizations should conduct formal carbon impact assessment (CIA) before developing and implementing any policy and strategy. Through CIA, organizations will realize the carbon impact of their activities at the strategic decision-making stage. Every business decision must be filtered through the 'carbon lens' to measure and mitigate carbon impact.
- CMPs need to be regularly reviewed and updated to make sure they are relevant and fit for purpose. Evaluation and reporting needs to be consistent with key performance indicators within and across sectors. Both senior and middle managers need to review carbon management progress to date to assess the effectiveness of policies and strategies through integrated reporting. There needs to be accountability for carbon management at the senior management level, with a clear chain of command. In addition, a clear line of coordinated operational and strategic responsibility is needed.

Acknowledgments

The authors would sincerely like to thank all of the interviewees and universities/organizations for participating in this research study.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Muhammad Usman Mazhar http://orcid.org/0000-0003-2749-6408
Richard Bull http://orcid.org/0000-0002-4372-3589
Mark Lemon http://orcid.org/0000-0001-9330-6372

References

1. Wright LA, Kemp S, Williams I. 'Carbon footprinting': towards a universally accepted definition. *Carbon Manage.* 2(1), 61–72 (2011).
2. Stern PC, Janda KB, Brown MA, Steg L, Vine EL, Lutzenhiser L. Opportunities and insights for reducing fossil fuel consumption by households and organizations. *Nat. Energy* 1, 16043 (2016).
3. HEFCE. *Carbon Reduction Target and Strategy for Higher Education in England*. HEFCE, Bristol, UK (2010b).

4. HEFCE. *Carbon Management Strategies and Plans: A Guide to Good Practice*. HEFCE, Bristol, UK (2010a).
5. WRI and WBCSD. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Revised Edition). The Greenhouse gas Protocol Initiative, Washington, USA and Conches-Geneva, Switzerland (2004).
6. Robinson O, Kemp S, Williams I. Consumption, production… or perfection? Exploring approaches to carbon footprinting in higher education institutions. In: *Handbook of Theory and Practice of Sustainable Development in Higher Education*. Springer International Publishing, Berlin, Germany, 441–452 (2017a).
7. Busch T, Shrivastava P. *The Global Carbon Crisis: Emerging Carbon Constraints and Strategic Management Options*. Greenleaf Publishing, Sheffield, UK (2011).
8. Carbon Disclosure Project. *The Carbon Management Strategic Priority*. Carbon Disclosure Project (CDP), London, UK (2010).
9. Wang X, Ding H, Wang W, Zhang L, Xue Y. A review of Carbon Emission Management from the perspective of logistics industry. In: Service Operations and Logistics, and Informatics (SOLI), *2012 IEEE International Conference*, Suzhou, China, 312–317 (2012).
10. Lee S. Corporate carbon strategies in responding to climate change. *Bus. Strateg. Environ.* 21(1), 33–48 (2012).
11. Bebbington J, Barter N. Strategic responses to global climate change: a UK analysis. *Chartered Ins. Manage. Accountants* 7(11), 1–10 (2011).
12. Kolk A, Pinkse J. Market strategies for climate change. *European Manage. J.* 22(3), 304–314 (2004).
13. Kanchanapiya P, Limphitakphong N, Pharino C, Chavalparit O. Evaluation of greenhouse gas emissions and reduction from the petrochemical industry in Thailand. *Greenhouse Gas Measurement and Management* 4(2–4), 161–177 (2014).
14. Cadez S, Czerny A. Climate change mitigation strategies in carbon-intensive firms. *J. Clean. Prod.* 112, 4132–4143 (2016).
15. Wehrmeyer W, Leitner A, Woodman P. *Lean and Green: Leadership for a Low-Carbon Future*. Chartered Management Institute, London (2009).
16. Davies JC, Dunk RM. Flying along the supply Chain: accounting for emissions from student air travel in the higher education sector. *Carbon Manage.* 6(5–6), 233–246 (2015).
17. Mazhar MU, Bull R, Lemon M, Mallaburn P. The current state of strategic carbon management within the UK higher education sector: leading the way forward?. *Proceedings of the 9th International Symposium on Sustainable Leadership*, *3–6 June 2014*, Salzburg, Austria 2014.
18. Bryan G, Cohen R, Stepan P. *Wider Public Sector Emissions Reduction Potential Research. A Final Report to the Department of Energy and Climate Change (DECC), UK*. Camco, London, UK (2011).
19. Klein-Banai C, Theis TL. Quantitative analysis of factors affecting Greenhouse Gas Emissions at Institutions of Higher Education. *J. Clean. Prod.* 48, 29–38 (2013).
20. Altan H. Energy efficiency interventions in UK higher education institutions. *Energy Policy* 38(12), 7722–7731 (2010).
21. Wittneben B, Okereke C, Banerjee B, Levy D. Climate change and the emergence of new organizational landscapes. *Organ. Stud.* 30(9), 1013–1015 (2009).
22. Mazhar MU, Bull R, Lemon M. A review and case study of strategic Carbon Management in UK higher education sector. *Proceedings of Royal Institution of Chartered Surveyors (RICS) COBRA Conference, September 2012*, Las Vegas, Nevada, USA (2012).
23. Robinson O, Simon K, Ian W. Carbon management at universities: a reality check. *J. Clean. Prod.* 106, 109–118 (2015).
24. Carbon Credentials. *The Higher Education Carbon Challenge*. Carbon Credentials, London, UK (2015).
25. HEFCE. *Consultation on Sustainable Development Framework*. HEFCE, Bristol, UK (2013).
26. Renz DO *Nonprofit Governance and the Work of the Board*. University of Missouri, Kansas City, USA (2007).
27. Robinson O, Tewkesbury A, Kemp S, Williams I. Towards a universal carbon footprint standard: a case study of carbon management at universities. *J. Clean. Prod.* (2017b). doi:10.1016/j.jclepro.2017.02.147.
28. Czerniawska F. *A Growing Business Concern: How should Business Adapt to a Low-Carbon World*? Management Consultancies Association, London, UK (2007).
29. Wen B. Carbon Management Strategy of Tourism in Response to Climate Change, Information Management, Innovation Management and Industrial Engineering (ICIII), International Conference on 2010, IEEE, Kunming, China, 209–212 (2010).
30. Williams ID, Kemp S. The importance of education to carbon management. *Carbon Manageme*. 4(2), 107–109 (2013).
31. Bull R, Janda K. The WICKED and wild challenges of fostering energy efficiency engagement in private and public organisations. *Proceedings of the 4th European Conference on Behaviour and Energy Efficiency (BEHAVE), 8 - 9 September 2016*, Coimbra, Portugal 2016.
32. Nejati M, Shafaei A, Salamzadeh Y, Daraei M. Corporate social responsibility and universities: a study of top 10 world universities' websites. *African J. Bus. Manage.* 5(2), 440–447 (2011).
33. Ozawa-Meida L, Brockway P, Letten K, Davies J, Fleming P. Measuring carbon performance in a UK university through a consumption-based carbon footprint: De Montfort university case study. *J. Clean. Prod.* 56, 185–198 (2013).
34. Turner D, Williams I, Kemp S, Wright L, Coello J, McMurtry E. Towards standardization in GHG quantification and reporting. *Carbon Manage.* 2(1), 61–72 (2012).
35. Universities UK. *Education, Consumer Rights and Maintaining Trust: What Students Want from their University*? ComRes Survey, Universities UK (UUK), UK (2017).
36. Lozano R, Lukman R, Lozano F, Huisingh D, Lambrechts W. Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. *J. Clean. Prod.* 48, 10–19 (2013).

Websites

101. HESA. Free online statistics - estates management - environmental information. (last modified 2014). https://www.hesa.ac.uk/index.php?option=com_content&view=article&id=2093&Itemid=239 (Accessed 30 January 2014).
102. EAUC. Embedding carbon management within public sector organisations. (last modified 2016). http://www.sustainabilityexchange.ac.uk/embedding_carbon_management_within_public_secto (Accessed 13 June 2016).
103. The Carbon Trust. Public Sector most committed to carbon reduction. (last modified 2013) https://www.carbontrust.com/about-us/press/2012/02/public-sector-most-committed-to-carbon-reduction/ (Accessed 14 December 2013).
104. Rugg R. How the British public sector is leading the world on climate change action, The Carbon Trust. (last modified 2013). http://www.carbontrust.com/news/2013/11/british-public-sector-leading-world-on-climate-change-action (Accessed 14 December 2013).